

## MEMORANDUM FOR RECORD

SUBJECT: Ohio River Mainstem Systems Study Filling/Emptying Hydraulic Model

1. An in-progress review meeting of the filling and emptying model for the Ohio River Mainstem Systems Study (ORMSS) was held at Vicksburg, MS on 13-14 March, 2000. A list of attendees is provided below.

<b><u>Name</u></b>	<b><u>Office</u></b>	<b><u>Phone/Fax</u></b>
Coy Miller	CELRH-EC-WH	(304) 529-5601/5960
Jason Merritt	CELRH-EC-DS	(304) 529-5741/5209
John Hite	CEERD-HN-N	(601) 634-2402/2041
George Herbig	CELRL-ED-TH	(502) 582-5750
Brian Huston	CELRL-ED-DS	(502) 582-6967/5108
Byron McClellan	CELRL-ED-D	(502) 582-5691/5108
David Schaaf	CELRL-ED-DS	(502) 582-6967/5108

2. Mr. Hite started the meeting by describing a series of tests that were conducted on an existing filling/emptying model to determine the potential effects of placing supplemental culverts over top of an existing lateral field. The existing filling/emptying model was built under the USACE Innovations in Navigation Projects (INP) program to investigate filling and emptying times for a nominal 1200-ft chamber using only the 11 lateral system that exists at the Greenup Locks and Dam auxiliary lock chamber. The existing model is at 1:25 scale, the same as the ORMSS F/E model. For discussion of this model, all lengths and widths are referred to in actual field dimensions, not model dimensions. Since testing for the INP program had been completed on that model, the group previously asked Mr. Hite to investigate filling/emptying times and hawser forces in a 600-ft chamber if two supplemental flat culverts were placed over a portion of the existing lateral field. In order to determine the effects on a 600-ft chamber, the existing model was shortened from 1200 feet to 600 feet by adding lower miter gates in the proper location in the model. Instrumentation was placed in the shortened model to determine longitudinal and transverse hawser forces for various valve operating times.

The existing auxiliary chamber at Greenup is 110 feet wide. The present design for providing supplemental filling/emptying capability to an extended chamber is to add two supplemental culverts over top of the existing lateral field to the lower portion of the extended chamber. The intakes will be through the upper miter gate sill. Each culvert was designed to be 29 feet wide. Therefore, approximately 58 feet of the laterals were covered (29 feet on each side of the chamber) to represent the new culverts going over the existing laterals. Mr. Hite conducted the filling and emptying of chamber with

various valve operating times both with and without the supplemental culverts in the 600-ft chamber.

The tests investigated filling and emptying times for valve operations at 3, 4, and 9 minutes both with and without the existing laterals partially covered. Figures 1 through 4 in the back of this memorandum show the results of the tests. Figure 1 depicts the filling time for a 600-ft chamber (on the horizontal axis) versus the hawser force in tons along the vertical axis. These tests were run with a representative 35-ft head. This represents the high end of the operating head ranges on the Ohio River. Greenup generally operates with a nominal 30-ft head. As evidenced by Figure 1, the maximum hawser force occurs in the upstream, longitudinal direction for a valve operation time of 3 minutes. Present guidance calls for a maximum hawser force of 5 tons. Using the upstream, longitudinal hawser force as the limiting case, the hawser force drops below 5 tons at approximately 11.6 minutes for the existing condition where the laterals are NOT partially covered. With the laterals partially covered, the filling time for a 5-ton hawser force actually drops to about 11.2 minutes.

Figures 2 and 3 show the time history lock chamber filling curves for a 4-minute valve operation with and without the laterals partially covered, respectively. As you can see, the maximum hawser force remains unchanged at 6.3 tons for both cases. However, the filling time for the case with the laterals partially covered is actually reduced from 9.5 minutes to 9.3 minutes when compared to the non-covered case (Figure 2).

Finally, Figure 4 depicts the emptying times for the same series of valve operations. As is typically the case, emptying hawser forces do not control the processing time as all forces fall below the 5-ton limit. Both cases, the with laterals partially covered and the existing condition, generally provide the same emptying performance.

In summary, the differences between the filling and emptying performance of the existing system versus the laterals being partially covered are negligible. If anything, providing the supplemental culverts on top of the existing laterals may slightly improve the performance of the lock chamber with respect to the filling and emptying times and hawser forces.

3. Messrs. Schaaf and Huston had prepared a set of plans consisting of 6 sheets for the 6-lateral system. Two sheets were dedicated to the existing system without the addition of supplemental culverts. The remaining 4 sheets laid out the extended chamber with supplemental culverts. During the discussion of the plans, several issues arose that opened up group discussion about the purpose and direction of the ORMSS F/E model. These “key” items are detailed below.

**a. Modeling the F/E System for the Existing 1200-ft Main Chamber.** This issue was brought up by Mr. Schaaf since he was unsure what to show for the existing main chamber. It was the group’s consensus that we should include the main chamber intakes since they vary between the 6 lateral and 11 lateral system. This will be included

in the model to determine the effects of filling both chambers at the same time. The group agreed that this would generally not happen, but thought that since we were building the model, it may be good to test to get a determination of the effects of simultaneously filling both chambers. The group agreed the main chamber culverts and outlet buckets for the main chamber did not need modeling. Only the intakes will be modeled and Mr. Hite will empty the water into the lower pool in an efficient manner since we are only concerned the action of the water relative to the intakes. An action item for Messrs. Schaaf and Huston is to provide details of the intake system for both chambers at J.T. Myers as soon as possible. **(Post meeting note – A set of plans detailing the intakes for both chambers at J.T. Myers has been sent to Mr. Hite by overnight mail. He should have them as of 3/22/00).** An additional piece of information Mr. Hite requested was the lock hydrograph for the main chamber at J.T. Myers. Mr. Herbig will get Mr. Hite the necessary information relative to the lock hydrograph.

**b. Location of Lock Chambers Relative to the Direction of Flow.** The original plan called for setting up the model to reflect the orientation of the lock chambers as they are at Markland. However, once the model was set up to examine general 6-lateral and 11-lateral systems, it was previously agreed by Mr. Hite and Mr. Schaaf that we would set up the 6-lateral system as it is relative to J.T. Myers and Newburgh since these are the only two 6-lateral systems on the lower Ohio River. For the 11-lateral system, the model will be changed such that the orientation of the locks versus direction of flow reflects the conditions at Greenup. The group thought this was a good idea since several individuals, possibly including tow captains, would be coming down to view and evaluate the model and we did not want confusion due to the orientation to skew anyone's perception of the model. Mr. Hite believed this would be a minor increase in cost, but worth the extra expense in order to eliminate confusion.

**c. Approach Wall Details for Modeling Effort.** Mr. Schaaf raised the issue regarding the details associated with modeling both the existing approach walls, but also the extensions of these walls with floating pontoons. Previously, the details associated with this item was not included in the model plans. Mr. Hite stated that he needed the details (dimensions, stations, elevations, etc.) for both the existing approach walls but also any modifications made as part of the extended lock chamber. This was a critical item to get to him, as construction of the model will commence from the upstream end to the downstream end. **(Post meeting note – Mr. Schaaf has express mailed a set of plans to Mr. Hite with all appropriate information for the approach walls, both existing and planned extensions. He should have received the package by 3/22/00.)** In addition, Messrs. Schaaf and Huston will ensure that the updated plans will include specifics regarding the details of the approach walls.

**d. Reverse Tainter Culvert Valve Plans.** Mr. Hite requested the details of the culvert valves for the 6-lateral system. **(Post meeting note – Mr. Schaaf included a detail sheet of the culvert valve at J.T. Myers with the express mail package sent to Mr. Hite.)**

**e. New Supplemental Culvert Details and Location.** After hearing the positive results from the series of tests on the partially covered existing laterals, the group agreed that it would be best if we could keep the new culverts at both edges of the chamber. This will be changed in the updated set of plans. The other concern regarding the plans was the transition zone from twin, flat, triple box culverts into a single 14' x 16' culvert in the land wall of the extended chamber. The plans at the meeting detailed a tricky transition both horizontally and vertically in order to allow assumed distances between culvert valves and lateral fields similar to those that exist in the field at J.T. Myers. This item was a point of much discussion about the best way to transition from the twin, flat culverts into a single culvert. Messrs. Miller and Merritt will investigate making changes to this portion of the plans to ensure a better transition area. This transition zone will control stationing used to place the lower lateral field. **(Post meeting note – Mr. Hite has been faxed three alternatives regarding the transition zone and will get back to us regarding the best choice.)**

**f. Other Issues.** The group agreed to keep 11 ½ feet as the minimum draft requirement when measuring lower pool to the top of the supplemental culverts. Mr. Herbig determined that 90% of the time, there would be a minimum 12 ½ feet given the lower pool histogram at J.T. Myers since the completion of Smithland Locks and Dam in 1979. Mr. Schaaf will revisit the cost estimate for the 6-lateral system once final changes are made to the plan for the model test. He will have to include possible anchoring of monoliths near the intake trench as well as the upper miter gate sill. Messrs. Schaaf and Huston need to determine the locations of the maintenance bulkhead slots that will be installed at J.T. Myers as part of the miter gate changeout program. The locations of these slots may need to be changed or the supplemental culvert adapted slightly to work around these slots. Mr. Miller stated that we may want to consider doing some simplified sediment modeling with this model if it is feasible. This may prove beneficial to answer any potential environmental concerns. Also, the group discussed testing the 6-lateral system model for filling/emptying of an extended chamber to determine its characteristics. The group agreed we may be able to use the existing model for Greenup to get that information.

4. The group visited the model as part of the meeting. Construction of the support requirements, such as operation of the hydraulic system to control pool, is underway. Additionally, construction of the lock walls and chamber floor has begun. Construction should pick up in later March/early April such that the model will be near completion by the end of April. In addition, the group also visited the approach wall model being constructed adjacent to the ORMSS F/E model as part of the Innovations Research Program. After discussing the attributes of the J.T. Myers and Greenup lock expansions, the group concluded that information being collected with the approach wall model would be beneficial to both projects. In order to study these effects, Mr. Schaaf was to send the details of the existing approach wall and floating wall extensions at J.T. Myers to Howard Park, who is leading that modeling effort, for him to possibly implement into the model.

5. Either the entire group or portion of the group will meet again towards the end of April while team members are in Vicksburg for other meetings. Mr. Hite may travel to Louisville to work with Messrs. Schaaf and Huston prior to this if questions arise regarding the plans.

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- \* GREENUP PRESENTLY FILLING AUX. CHAMBER AROUND 8 1/2 TO 9 MINUTES, BUT OPERATING HEAD IS USUALLY 30-FT, NOT 35-FT HEAD

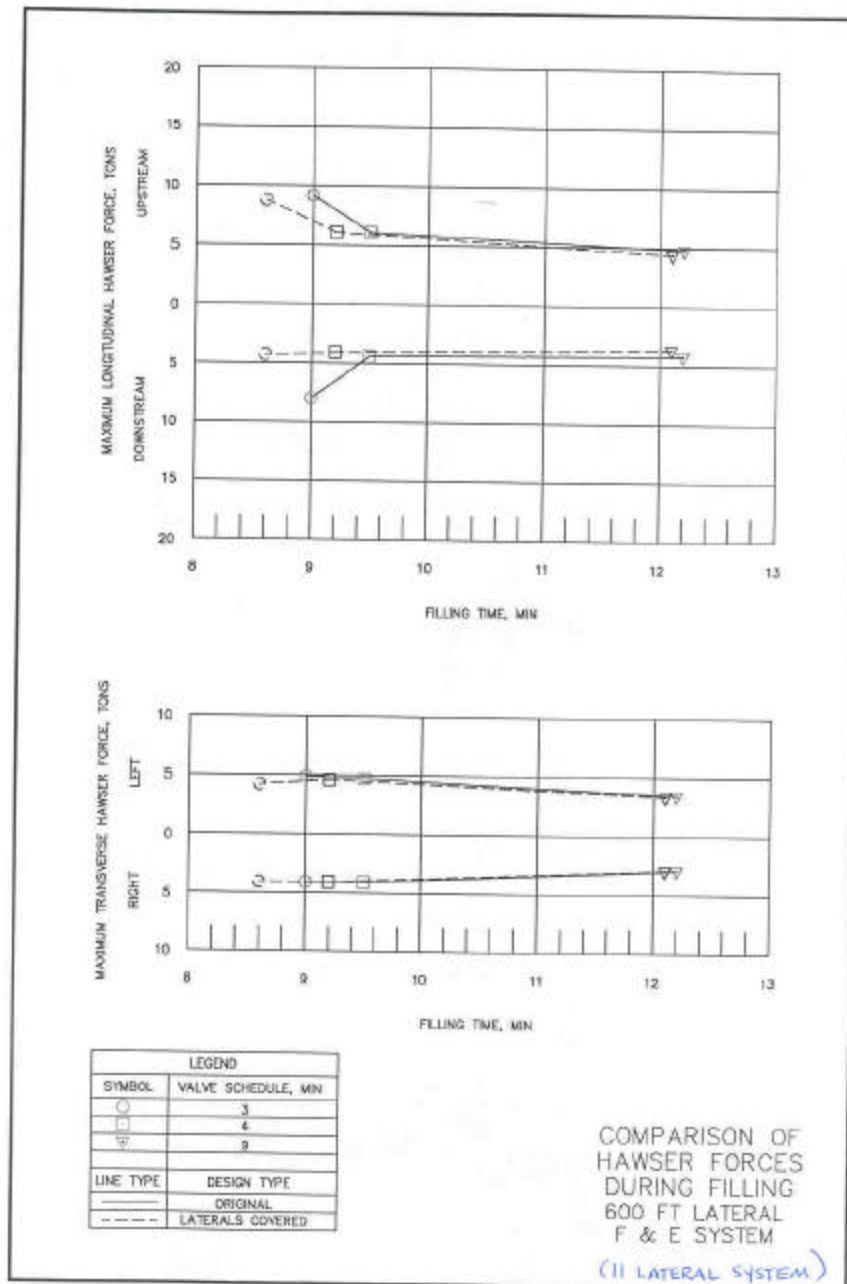


FIGURE 1.

• INSTALLED GATE AT 670' LENGTH  
TO REPLICATE AUX. CHAMBER

• NO COVER OVER LATERALS

• MODIFICATIONS TO EXISTING F/E  
MODEL RESULTS (5 TONS PRESENT ALLOWABLE)

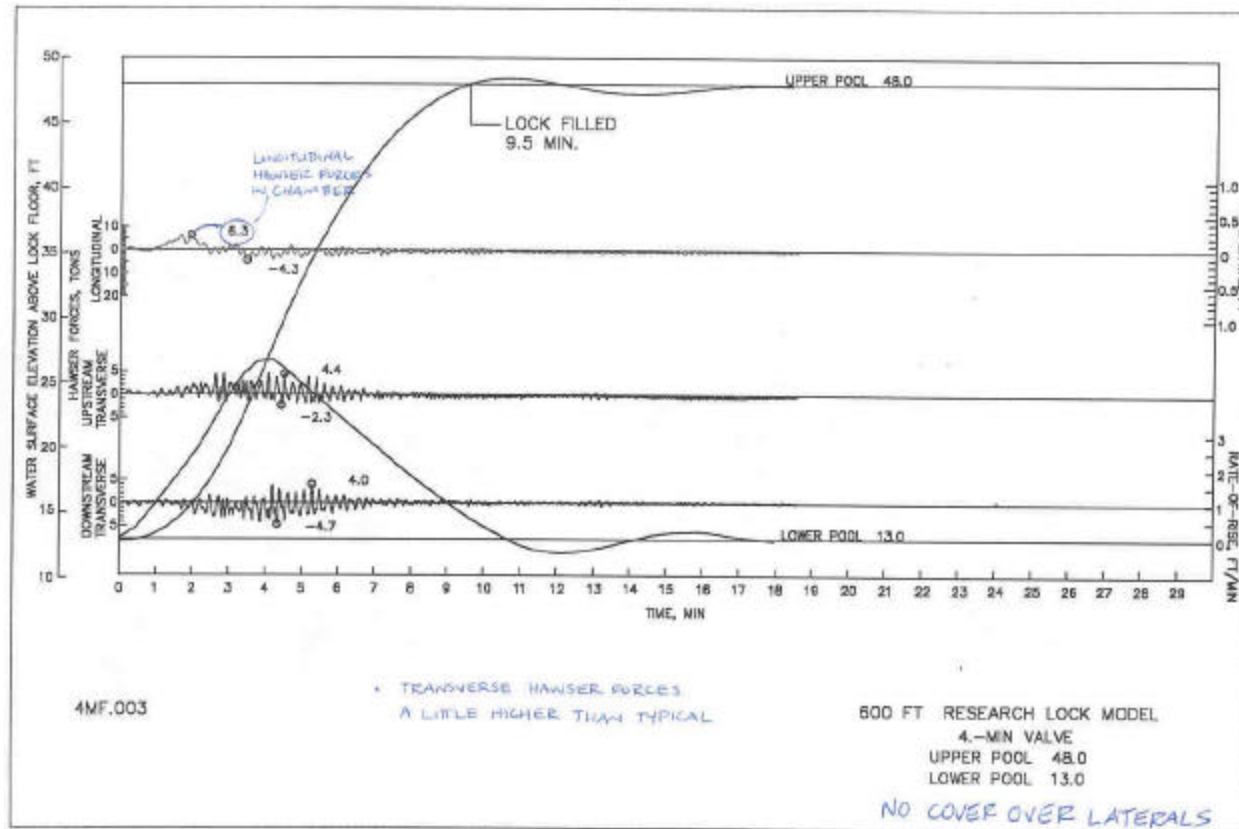


FIGURE 2.

• WE HAVE NOT HURT THE HAMSER FORCES BY PARTIALLY COVERING THE TOPS OF THE LATERALS.

• COVERING REPRESENTED BY 29-FT CULVERTS AGAINST THE SIDES.

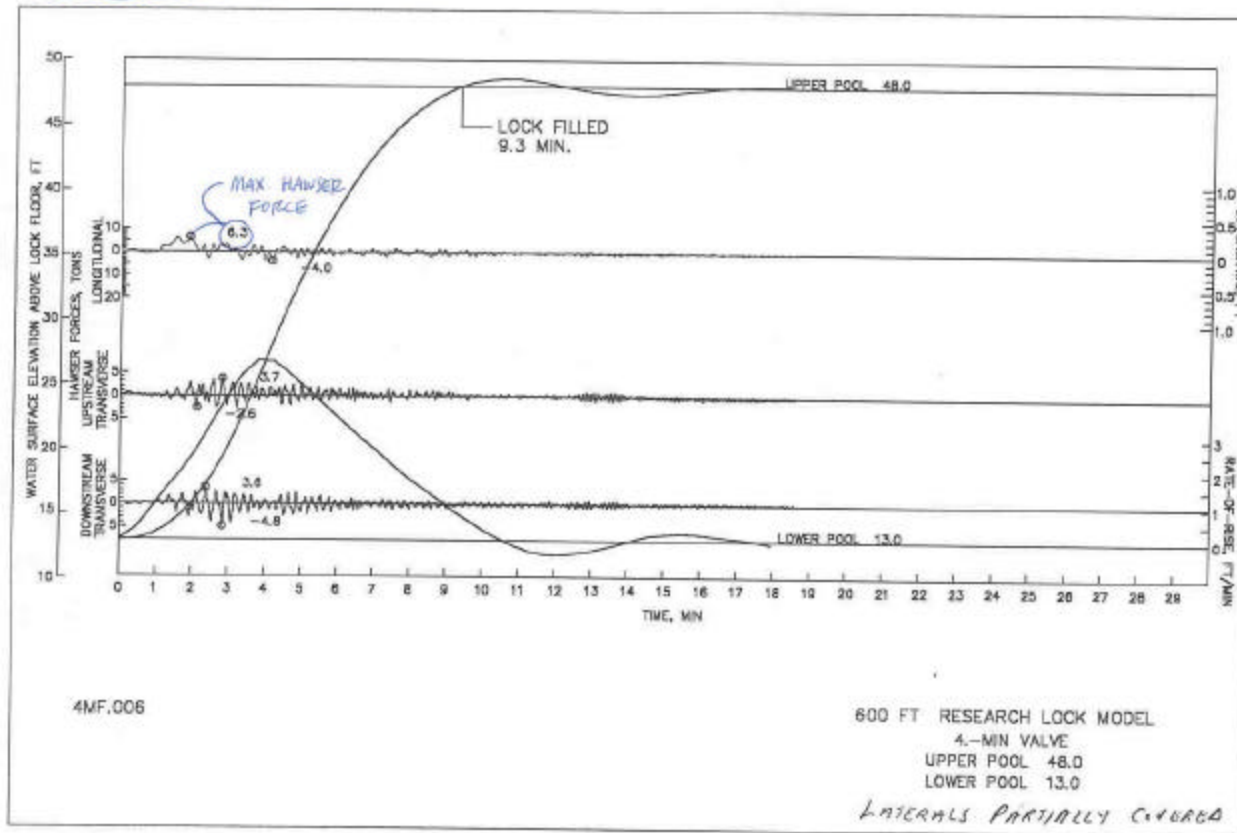


FIGURE 3.



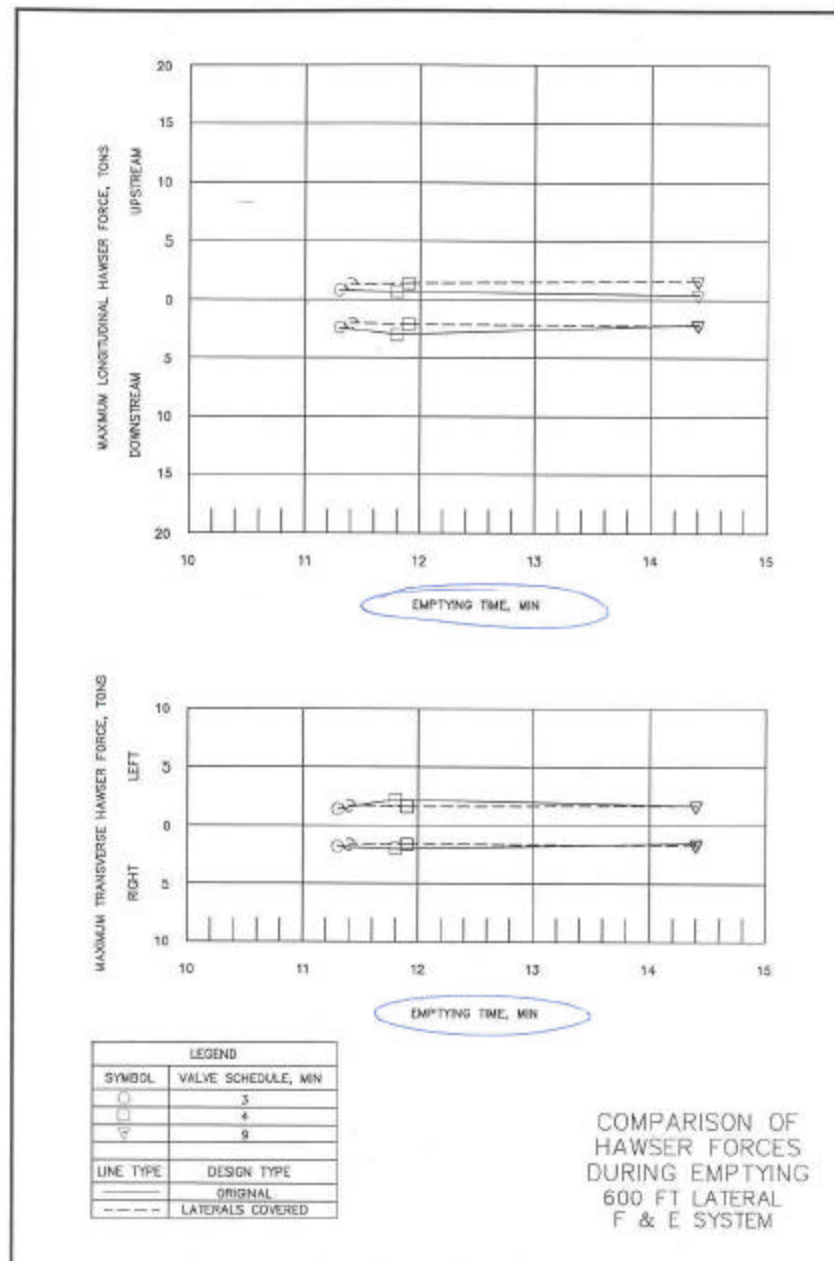


FIGURE 4.